

# Pre-injector Upgrade Updates (01 Sep – 15 Sep 2010)

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15 Sep 2010

# Solenoid Parameters

| Parameter                | Unit              | Value                  |   |
|--------------------------|-------------------|------------------------|---|
| Solenoid peak field      | T                 | 0.45                   |   |
| Integral ( $B_z^2$ )dz   | T <sup>2</sup> -m | 0.0154                 |   |
| Current                  | A                 | 500                    | ← |
| Number of turns          |                   | 78                     |   |
| Ampere-turns             | kA                | 39                     |   |
| Inductance               | mH                | 3.7                    | ← |
| Conductor                | mm                | 10.4 x 10.4, dia. 5.82 |   |
| Voltage                  | V                 | 7.5                    | ← |
| Power loss               | kW                | 3.75                   |   |
| Water pressure drop      | MPa               | 0.5                    |   |
| Number of water circuits |                   | 1                      |   |
| Water flow               | l/min             | 2.5                    |   |
| Water temperature rise   | °C                | 22                     |   |

# Quad Params

| Parameter                                       | Unit              | Value                |
|---|-------------------|----------------------|
| Quadrupole gradient                             | T/m               | 39.25; 31.11;16.85   |
| Pole tip radius                                 | mm                | 20                   |
| Quadrupole effective length                     | mm                | 45                   |
| Quadrupole integrated gradient                  | T                 | 1.77; 1.4; 0.76      |
| Dipole corrector integrated field               | T-m               | 0.006                |
| Copper conductor dimensions                     | mm                | 5.0 x 5.0, ø3.0      |
| Copper area                                     | mm <sup>2</sup>   | 17.64                |
| Quadrupole number of coil turns                 |                   | 8                    |
| Dipole number of turns                          |                   | 2                    |
| Quadrupole peak current at 1.77 T int. gradient | A                 | 650                  |
| Dipole peak current at 0.006 T-m int. field     | A                 | 650                  |
| Current pulse form                              |                   | 60 Hz half sine wave |
| Repetition rate                                 | Hz                | 15                   |
| R.M.S. current factor                           |                   | 0.0884               |
| Quadrupole and dipole r.m.s. current            | A                 | 57.5                 |
| Current density                                 | A/mm <sup>2</sup> | 3.25                 |
| Quadrupole and Dipole inductances               | μH                | 166; 5.2             |
| Quadrupole and Dipole DC resistances            | Ω                 | 0.7; 0.13            |
| Quadrupole and dipole DC voltages               | V                 | 460; 85              |
| Quadrupole and Dipole Inductive voltages        | V                 | 20.3; 0.6            |
| Quadrupole and Dipole power losses              | kW                | 2.5; 0.5             |
| Number of water circuits                        |                   | 2                    |
| Water pressure drop                             | atm               | 5.0                  |
| Water flow                                      | l/min             | 3.0                  |
| Water temperature rise                          | °C                | 14                   |

# Solenoid DC PS Requirements

| Parameter           | Requirement                                 |
|---------------------|---|
| Ripple              | < +/- 0.25A @ 500A                          |
| Noise               | < $7.5 \mu\text{A}/\sqrt{\text{Hz}}$ @ 500A |
| Regulation          | < 1 s*                                      |
| Long term stability | < 0.25A change in 6 months                  |
|                     |   |
|                     |   |
|                     |   |

Ripple requirement: Trace3D calculation < 1% envelope mismatch

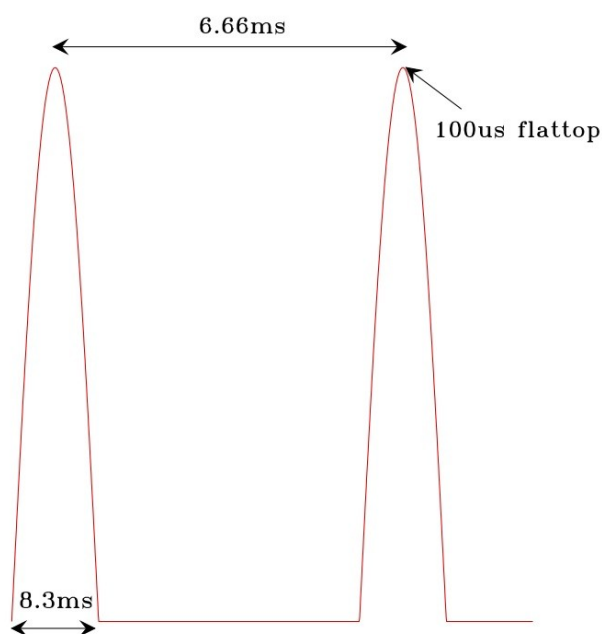
Noise: Assume gaussian white noise. Assume  $3\sigma$  for gaussian PDF to give < 1% envelope mismatch.

\* Must reach current setting < 1s

# Quadrupole PS requirements

| Parameter                 | Value                                 |
|---------------------------|---------------------------------------|
| Stability for 100 $\mu$ s | +/- 0.2% @ 500A                       |
| Ramp rate                 | 15 Hz                                 |
| Rise time                 | ~ 4ms*                                |
| Fall time                 | ~4 ms*                                |
| Maximum voltage           | < 2kV                                 |
| Stability                 | +/- 0.2% @ 500A<br>change in 6 months |

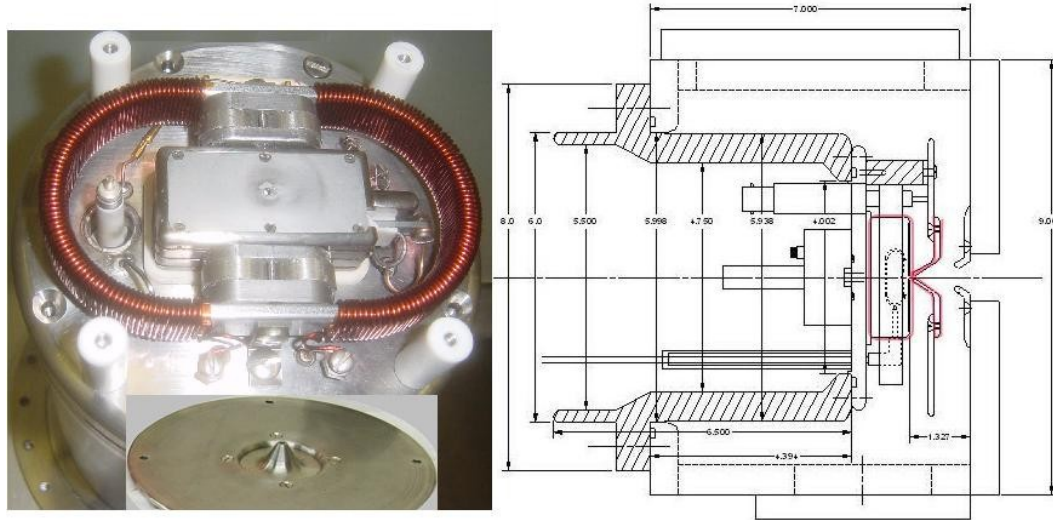
2<sup>nd</sup> quad is the most sensitive. 1% reduction in capture for 0.2% change. 2<sup>nd</sup> quad is weaker and runs at 550A.



\*Rise and fall time should be determined by the stability of the current at flattop for 100  $\mu$ s.

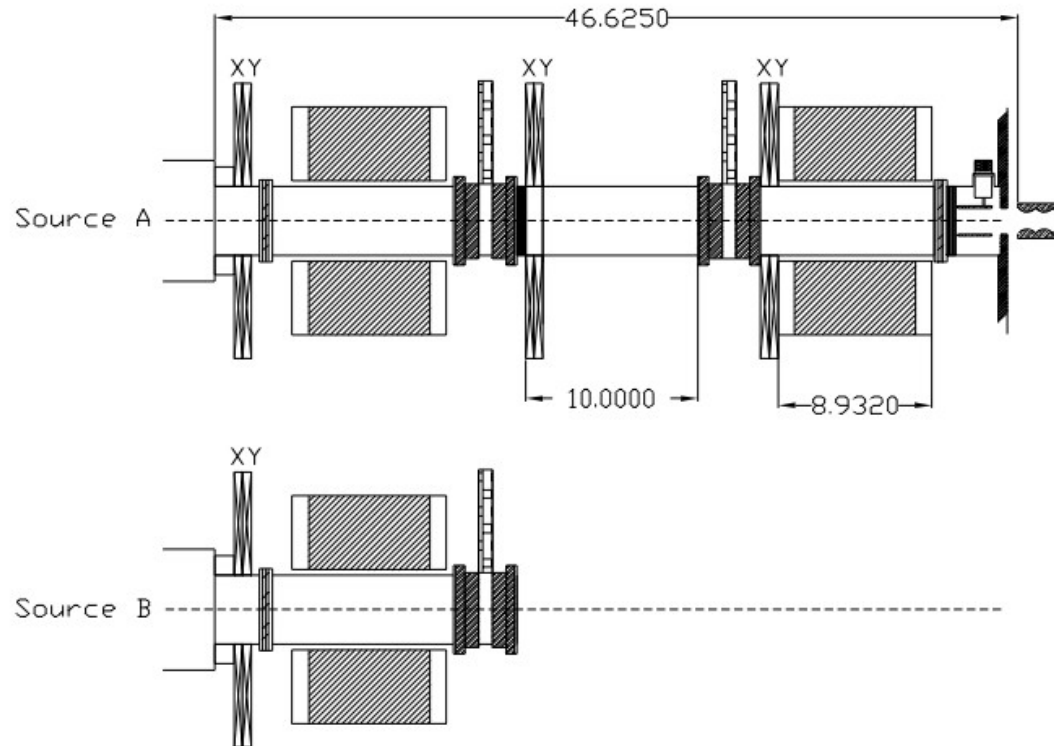
Picture assumes  $\frac{1}{2}$  sine wave at 60Hz.

# Source Status



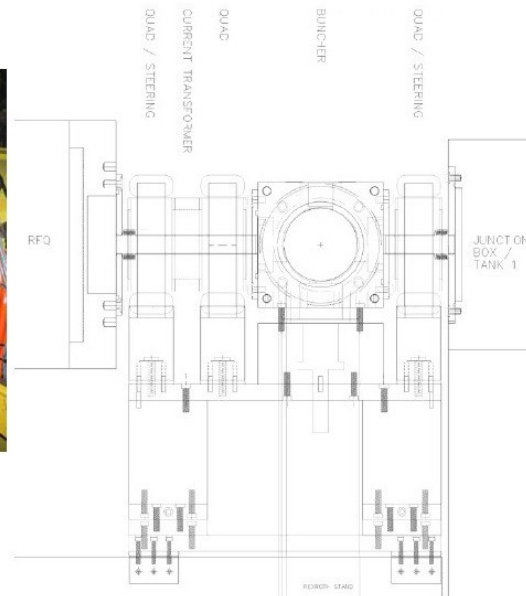
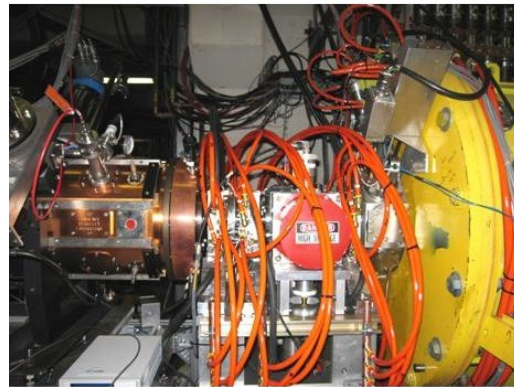
| Device | Status   | Comments                                    |
|--------|--|---|
| Source | Problem with sparking traced to connector used by HINS     | connector is covered with ceramic over now. |
| Pulser | Upgraded with new transformer allows pulser to go to 38 kV | As of 10 Sept 2010                          |

# LEBT Status



| Device              | Status                 | Comments  |
|---------------------|------------------------|---|
| Power for solenoids | First pass at specs    | Specs given to George Krafczyk                        |
| Correctors          | Bdl=186.5 gauss inches | Specs being looked at before vendor bidding.          |
| Einzel Lens         |                        | Beam shot at it at >35kV. No sparking                 |
| Pulser for Einzel   | To be designed         | Build with thyratrons for test.                       |
| Solenoids           |                        | PO done. Expect 1 <sup>st</sup> solenoid end of year. |
| Toroid              | before sol 2           | Cannot be inside tank                                 |

# MEBT Status



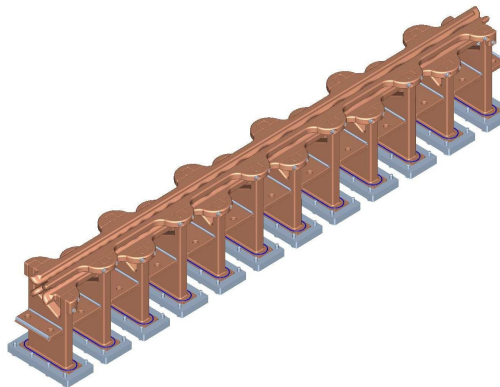
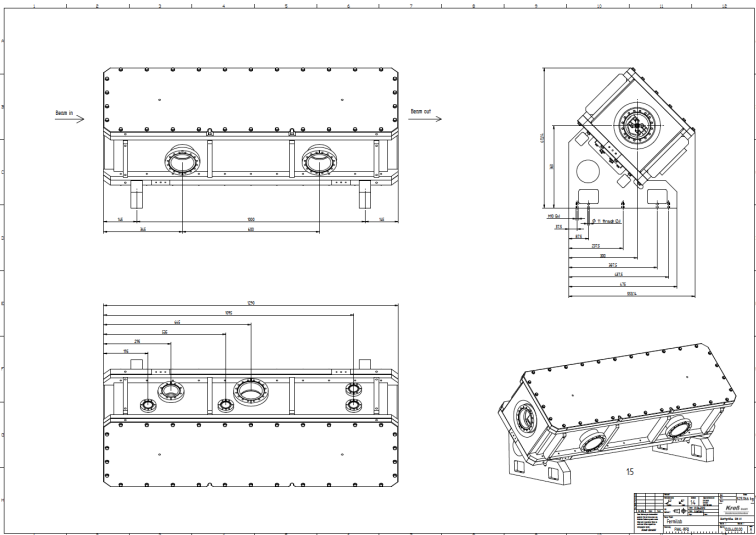
| Device             | Status   | Comments  |
|--------------------|--|---|
| Quads              | Design in progress. Includes dipole corrector in quad. | Question as to whether sextupole component will be a problem. |
| Buncher            | Specs given to vendor.                                 |   |
| Power for quads    | First pass at specs                                    | Specs given to George Krafczyk                                |
| Power for buncher  |  | Use present buncher supply in the line.                       |
| Connection to Tank | Remove large flange of Tank1                           |   |



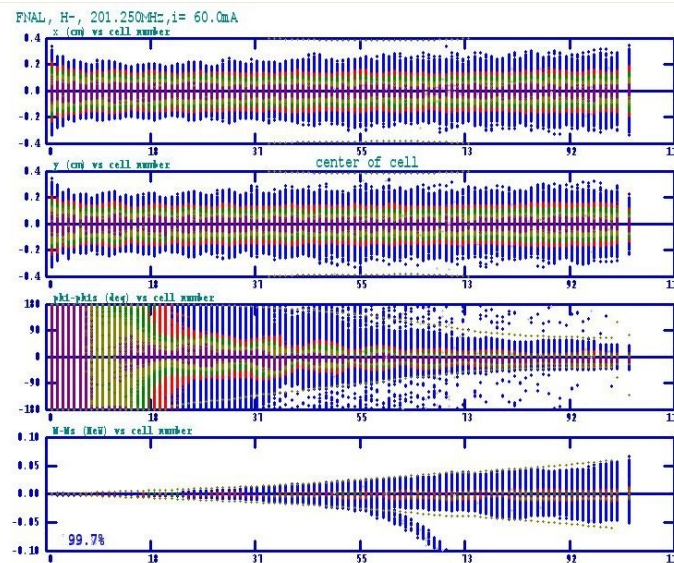
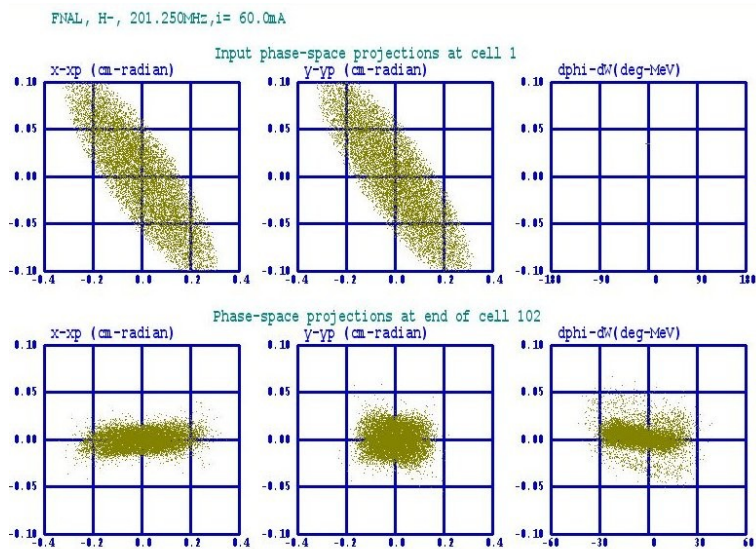
# RFQ Status

- Coax cables need to be ordered for PA to RFQ.
- PA being assembled.
- Schempp (25 Aug 2010)
  - Parts are being procured.
  - Rectangular box rather than round tube because it's a better design.
  - Some pictures of the RFQ (next slide)

# RFQ



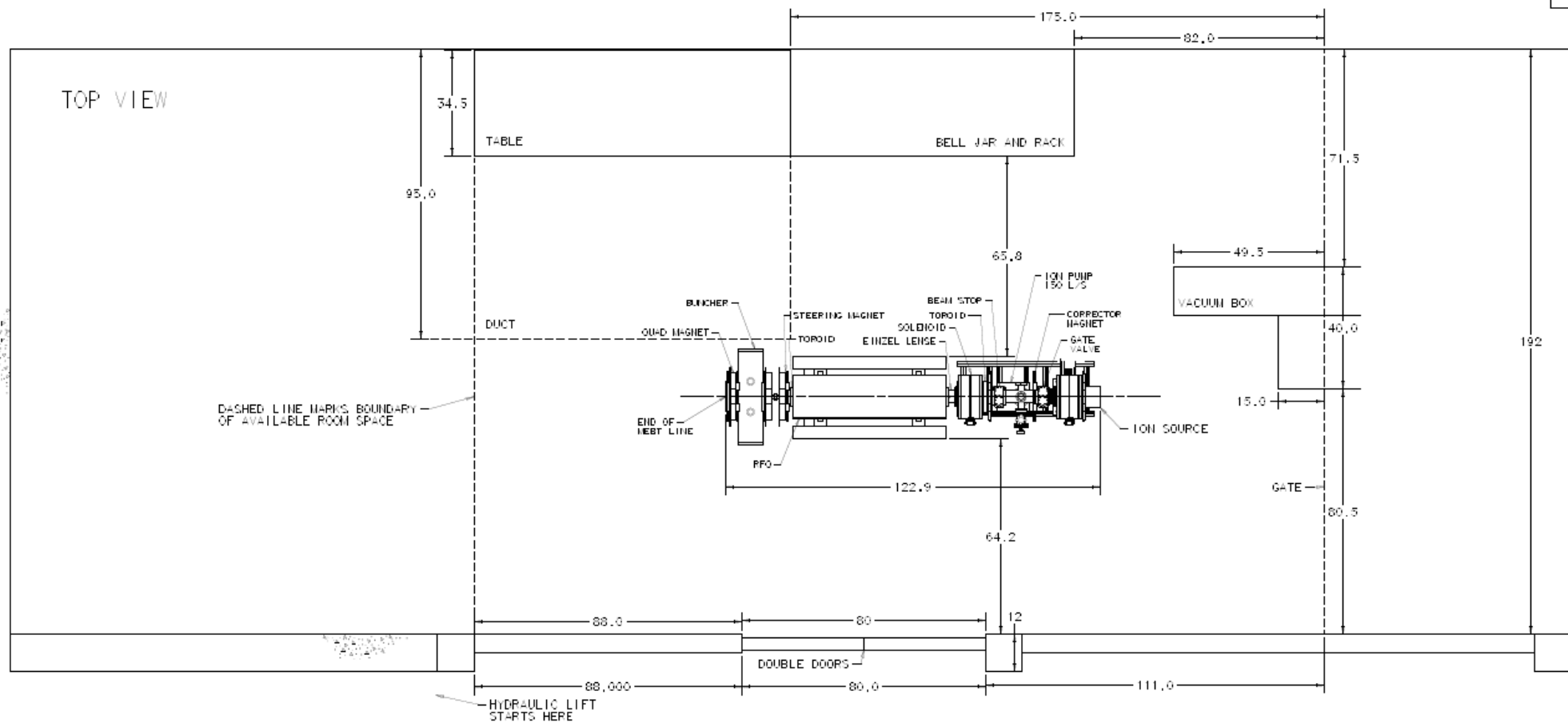
- 750keV RFQ.
- 60mA beam current
- 1.3m long.
- Rod design.
- Alwin Schempp designer
- Expected delivery, early 2011



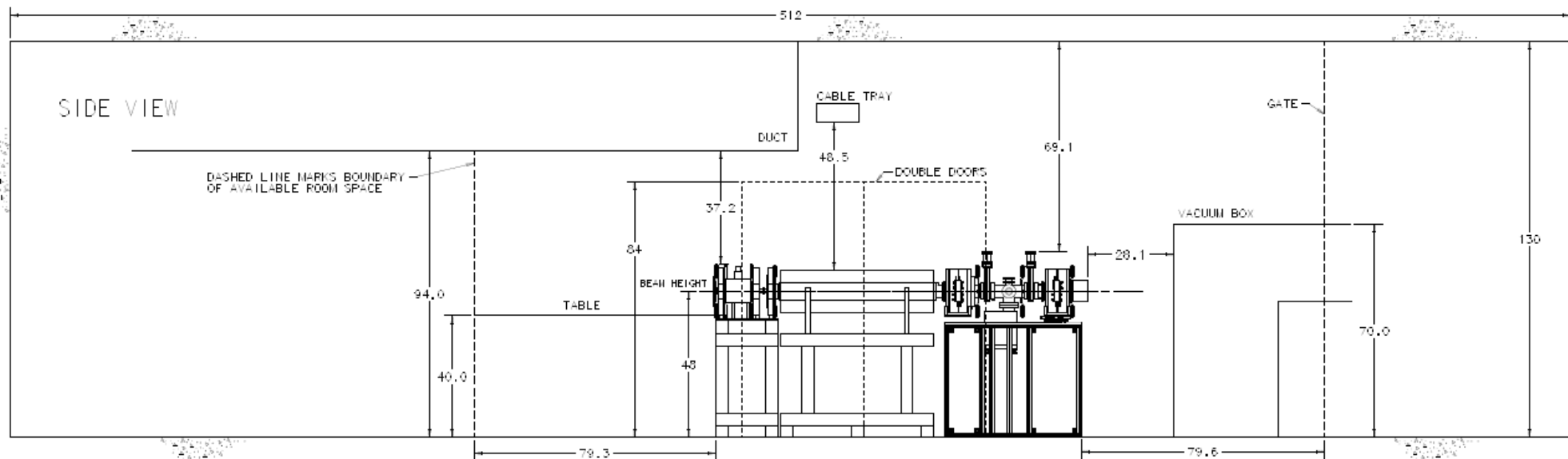
# Test Stand

- Room has been cleaned up.
  - After beam line layout (progress?)
    - Water – Bob Slazak
    - Electrical – Jim Ranson
- Need to test LEBT before RFQ connection
  - Wires, toroids at the end of the LEBT, same position as the RFQ.

## TOP VIEW



## SIDE VIEW



# Safety

- When can the beam line layout in test area be done?

# Controls

- Mike Kucera will need to be involved.

# RFQ reminders

- Schempp is vendor
  - Make sure that the vanes are cleaned! See ISIS email.
    - Some cleaning details supplied by ISIS.
  - Review and verify on site mechanical design and construction (already in contract).